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ABSTRACT

This Missouri Vocational Instruction Management System instructor's drafting guide has been keyed to the drafting competency profile developed by state industry and education professionals. This unit contains information on computer-assisted drafting drawings. The guide contains a cross-reference table of instructional materials and 20 worksheets. (NLA)

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Module

6 COMPUTER ASSISTED DRAFTING (CNC) DRAWINGS

70-4006-1
Instructor's Guide

ED336603

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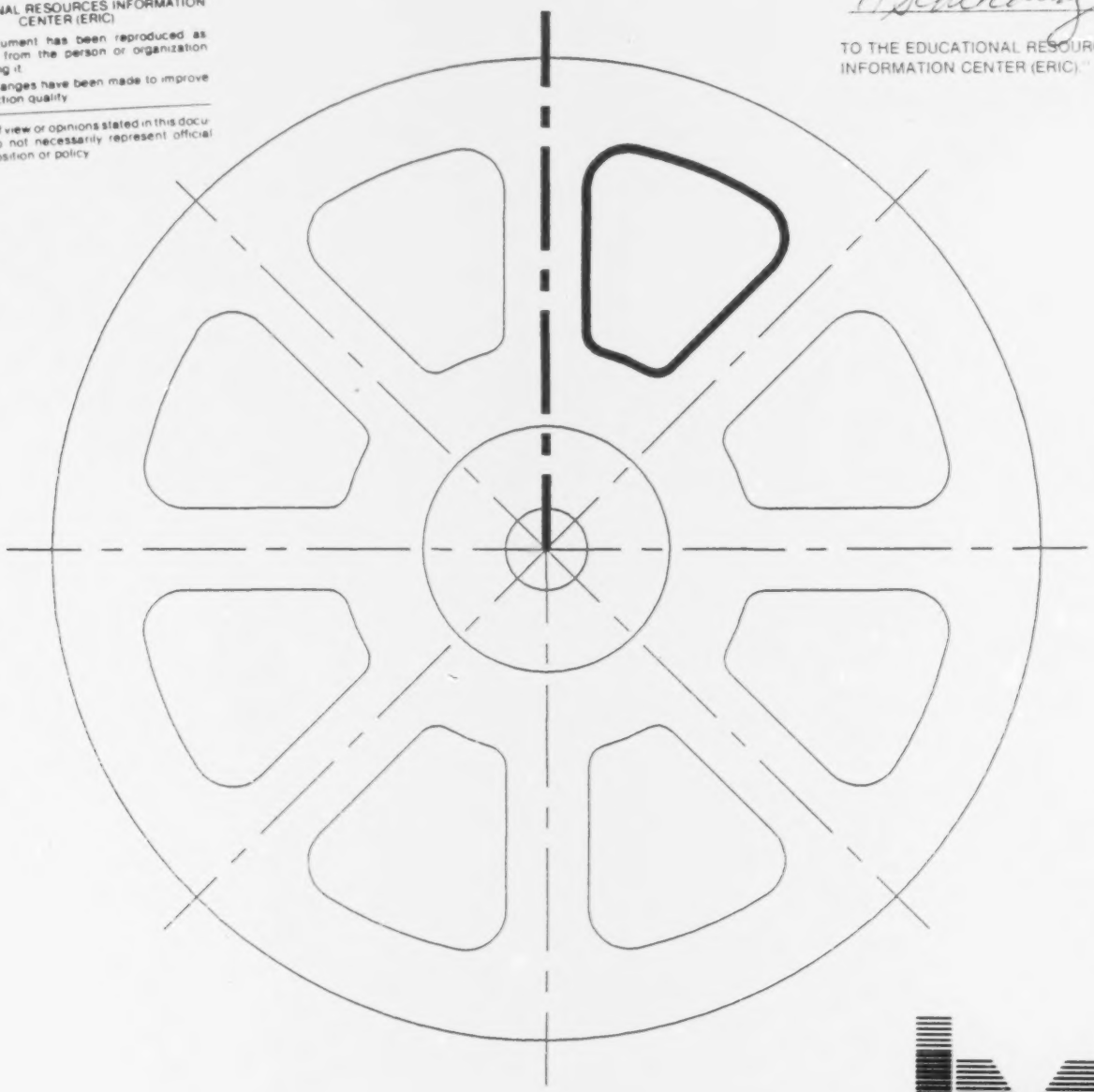

Instructional Materials Laboratory, University of Missouri-Columbia, Columbia, Missouri

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DRAFTING

Module 6: Computer Assisted Drafting (CAD) Drawings

Instructional Materials Laboratory
8 London Hall
University of Missouri-Columbia
Columbia, MO 65211

1991

Instructor's Guide
Catalog N. 70-4006-I

FORWARD

Once again, we are indebted to the teachers and administrators who provided their time, effort and professionalism to develop curriculum guides for trade, technical and industrial education programs. This drafting guide is an outstanding example of what can be accomplished when the right people with the right attitude get together. Committee members worked hard over several years' time in advisory, writing, technical consultation and field-test capacities.

This guide is designed to be totally integrated with the Vocational Instructional Management System. It is hoped that all guides produced under our supervision will help classroom teachers manage instruction. A curriculum guide is more than a resource--it is an integral part of the management system. Rather than impeding instruction, it should guide and facilitate instruction.

This guide's format has been set up for competency-based teaching and testing. Unit tests evaluate specific competencies and can be used with the Vocational Administrative Management System (VAMS). Information sheets, transparency masters, job sheets, assignments sheets and test items are keyed to specific competencies. A cross-reference table has been included to identify quickly the parts of the curriculum that relate to specific competencies. The material has also been packaged for students.

Although this guide may be a new format for some teachers, we are confident that, when used as designed, time spent by teachers and students will become more productive. Any future drafting curriculum modifications will begin with this guide. The drafting field is undergoing constant and considerable change. We will annually evaluate the need to update this guide on a module-by-module basis. Your suggestions regarding ares for improvement are both encouraged and appreciated.

Judith Moore, supervisor
Industrial Education
Department of Elementary and Secondary Education

Charles "Chuck" Waibel, director
Industrial Education
Department of Elementary and Secondary Education

SPECIAL NOTE TO INSTRUCTORS CONCERNING MODULE 6, GEOMETRIC DIMENSIONING AND TOLERANCING

Module 6 is different from most of the other modules in this curriculum guide. It is based on a separate book not included in the guide. Computer Aided Drafting (see enclosed order sheet) was also developed with funding from the Department of Elementary and Secondary Education, Division of Vocational and Adult Education. The Computer Aided Drafting curriculum contains objective sheets, information outlines, transparency masters, handouts and unit tests. The committee supervising the development of this guide decided that it would not be necessary or cost effective to duplicate work already done. You may order Computer Aided Drafting from Instructional Materials Laboratory.

Included in this module are 20 worksheets (job sheets).

HOW TO USE THIS PUBLICATION

GUIDE COMPONENTS

Units of instruction

This Drafting guide contains ten modules of instruction. Within each module are instructional units including some or all of the following components: performance objectives, information sheets, transparency masters, handouts, assignment sheets, job sheets and a unit test. Special instructions on audiovisuals, supplies, etc., are included in the Notes to the Instructor section near the beginning of each unit.

Competency profile

On the Missouri competency profile, tasks are divided into general subject areas, or duty bands, which are identified by a capital letter. Under each duty band are related tasks (competencies), which are identified by an Arabic numeral. To evaluate the student on performance of the competencies, a 3-2-1-N grading system is used, where:

- **3** = **Mastery** - can work independently with no supervision
- **2** = **Requires supervision** - can perform job completely with limited supervision
- **1** = **Not mastered** - requires instruction and close supervision
- **N** = **No exposure** - no experience or knowledge in this area

Cross-reference table (color-coded white)

Once the numbering system is understood, this table quickly reveals how the instructional components of the module relate to Missouri competencies. On the competency profile, tasks are divided into general subject areas, or duty bands, which are identified by a capital letter. Under each duty band are related tasks (competencies), which are identified by an Arabic numeral.

On the cross-reference table, unit numbers are represented by Roman numerals (I, II, III, etc.). Lessons within a unit are shown with Arabic numerals. Therefore, the first objective in Lesson 1 is numbered 1.1, the second is 1.2, etc. Other components of the module (transparencies, handouts, assignment sheets and job sheets) also use this numbering system. By looking at the cross-reference table, the instructor can quickly determine what test questions or job sheets a student needs to receive an evaluation on a particular competency.

Objectives (color-coded white)

Each unit is based on performance objectives that state the measurable unit and specific behavioral or performance objectives that students are expected to achieve. Since the objectives of the unit provide direction for the teaching-learning process, it is important for the teacher and students to have a common understanding of the objectives. Teachers should feel free to add/adapt objectives which will fit the material to student and community needs. Supporting material will, of course, need to be added for any new objectives.

Table of contents, references, notes to the instructor (color-coded pink)

These pages have been coded pink for instructor use only. The reference section lists materials used as sources in developing the material. Special instructions on audiovisuals, supplies, etc., are included in the Notes to the Instructor section.

Information sheets (color-coded green)

Presented in outline form for clarity, these pages provide content essential for meeting the cognitive (knowledge) objectives in the unit. Students should study the information sheets before class discussion or completion of assignment sheets. **CAUTION** statements indicate possible equipment damage, while **WARNING** statements recommend procedures to avoid bodily injury. Handouts and transparency masters are noted in the information sheets for instructional use.

Transparency masters (color-coded white)

Transparencies provide information by visually reinforcing or clarifying ideas presented in the information sheets. They are effective when identification is necessary, and they direct students to the topic of discussion. Transparencies should be left on the screen only when topics shown are under discussion.

Handouts (color-coded white)

Whenever more detailed information than can be presented in a transparency is needed, a handout is used. Handouts give the students additional information that can be kept with their class notes or student references.

Assignment sheets (color-coded tan)

Assignment sheets furnish paper-and-pencil practice to develop the knowledge necessary as a prerequisite to skill development. They can be given to students for class completion or used as homework assignments. Answer sheets (color-coded pink) can be used by the student or instructor to check progress.

Job sheets (color-coded blue)

These evaluation instruments are provided for two purposes: to outline steps of procedure and to check student performance mastery. Job sheets begin with a list of tools and materials needed for the activity. Job sheets furnish potential employers with a picture of skills being taught and performance that might be reasonably expected from a vocational student. The spaces to the right of the page on a job sheet assist the instructor in evaluating a student on a particular activity. This 3-2-1-N grading system is the same as the one used on the competency profile.

Unit test (color-coded yellow)

Competency-based tests are designed to help eliminate subjective testing and to improve student evaluation and accountability. Specific competencies and test questions are linked on the answer key. These unit tests have been written to be used with computerized VAMS (Vocational Administrative Management System), using Scantron sheets for computer-recording of test answers.

The unit test may be eliminated if the competency was thoroughly evaluated by job sheets. However, an emphasis should be placed on cognitive as well as performance skills. If the objective or competency will be evaluated by a job sheet, it is often necessary to determine by a written test whether the student understands enough of the material to perform the job sheet.

SUGGESTED ACTIVITIES

The following list of suggested activities may be helpful, especially to the beginning instructor.

1. Provide students with objective sheet and information sheets.
2. Discuss unit and specific objectives.
3. Discuss information sheets, assignment sheets and/or job sheets, lesson by lesson.
5. Give students unit test.
6. After successful completion of the test, have students do job sheet(s).

Students should perform the following activities.

1. Read objective sheet.
2. Study information sheets.
3. Do assignment sheet(s).
4. Take unit test.
5. Do job sheets.

Drafting

Module: Computer Assisted Drafting (CAD) Drawings

Cross-Reference Table of Instructional Materials

Competency	Unit	Instructional Objective	Transparency Master	Handout	Assignment Sheet	Job Sheet	Test Item	Notes
R-3						1 - 20		
R-4						1 - 20		

For additional support of your Drafting materials, consider the following publication.

Computer Aided Drafting - Generic instructional materials for basic groundwork in CAD for drafting students. Instructors are encouraged to modify or augment lesson plans by customizing them to the school's CAD system. Guide includes goals of units, lesson objectives, informational assignments, references, introduction, outline, summary and conclusion, interaction items, classroom/laboratory activities, and evaluation items. It also includes system-specific handouts covering the basic operations of the CAD software used in the classroom.

Use the handy order form below or call our toll-free number for additional information.

ORDER FORM

Instructional Materials Laboratory
2316 Industrial Drive • Columbia, Missouri 65202
Toll Free 1-800-669-2465

Date of Order: _____ **Signature:** _____ *(person placing order)*

Send Invoice To:	Ship To:
School or Firm:	Name and Title:
Address:	School or Firm:
	Address: (no P.O. box)
City, State, Zip:	
Purchase Order Number:	City, State, Zip:

Title	Catalog Number	Quantity	Unit Price	Net Price
Computer Aided Drafting, Instructor	70-4200-I		15.00	

Sub-total:	
Less 15% Missouri Only Discount:	
Shipping prepaid & added to invoice: ($3.85 minimum)	
TOTAL AMOUNT:	

MISSOURI RESIDENTS, DON'T FORGET THE 15% INSTATE DISCOUNT!

HANDS-ON ACTIVITIES FOR THE CAD STUDENT

(A SUPPLEMENT TO SPECIFIC SOFTWARE TRAINING)

by
Greg Peck

CAD WORKSHEETS

CONTENTS

SHEET #	*DESCRIPTION*
1	DRAWING COMMANDS, simple figures, not to scale
2	CARTESIAN COORDINATES, write the commands
3	RELATIVE INPUT, write the commands
4	POLAR COORDINATES, write the commands
5	DRAWING COMMANDS, write the commands
6	DRAWING COMMANDS, write the commands
7	EDITING COMMANDS, write the commands
8	EDITING COMMANDS, write the commands
9	EDITING COMMANDS, mirror
10	EDITING COMMANDS, array
11	EDITING COMMANDS, edit line & circle to create drawing
12	GEOMETRIC CONSTRUCTION, accurate construction yields accurate results
13	DRAWING COMMANDS, hatching
14	TEXT COMMANDS, create your own diploma
15	DIMENSIONING, dimensioning practice
16	DIMENSIONING, dimensioning solution
17	DIMENSIONING, datum dimensioning from radius and angle
18	SYMBOLS (BLOCKS), creation and use of symbol library
19	ORTHOGRAPHIC DRAWING, 3-view drawing
20	3D DRAWING, isometric, 3D wire frame, surface model, solid model or rendering

PREFACE

The assignments in CAD WORKSHEETS are intended to be used with any kind of CAD software and hardware. They provide the student with activities to reinforce the software specific information covered in the manual. Several assignments require the student to provide written information while others are actual drawing assignments to be done on the CAD system.

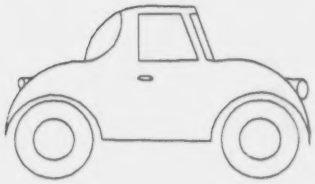
Note to Instructors

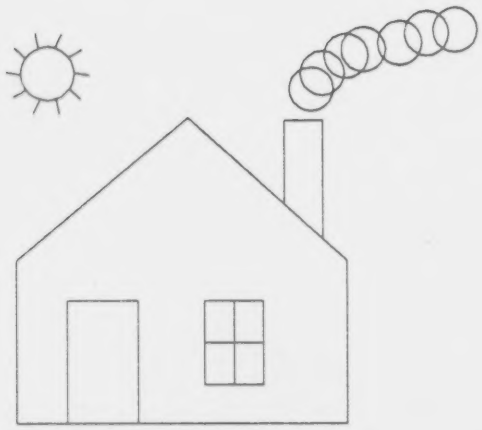
Several of the assignments can cover the necessary information in a lot less time if the student is not required to start from scratch. Worksheets 9, 10, 11, 13, 15, 16 and 18 would better serve the student if a file could be loaded to start from. It works very well to have your "star" student save their work at the appropriate point for later use.

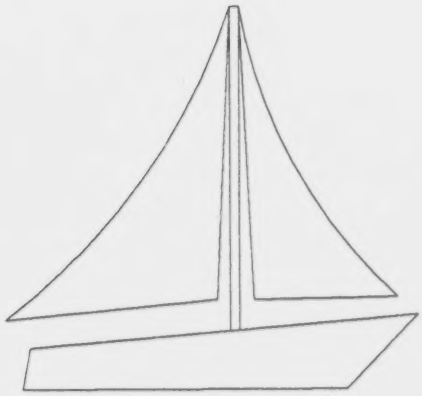
Additional worksheets (with a thin border) requiring written input are provided so that the instuctor can easily provide additional work for those that need it. Copy the empty sheet, add your own problem and duplicate for your student.

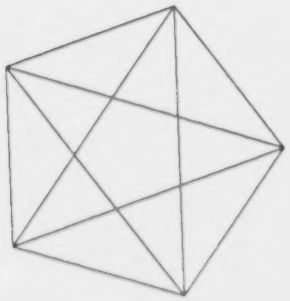
CAD WORKSHEET NUMBER 1

DRAWING COMMANDS









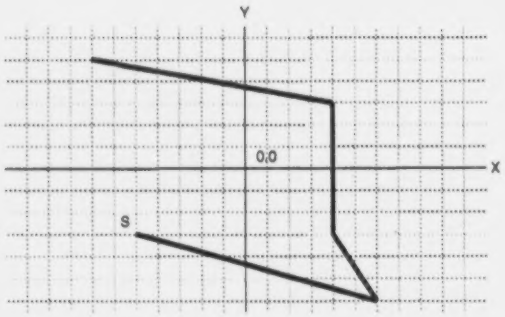
DIRECTIONS

1. Without regard to scale or size, duplicate the drawings above using various draw commands.
2. Feel free to improve on them.

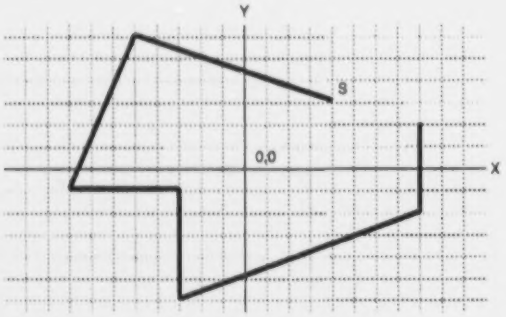
NOTE: Do not concern yourself with everything being perfect. The purpose is practice draw commands. Methods to improve accuracy will be covered later.

CAD WORKSHEET NUMBER 2

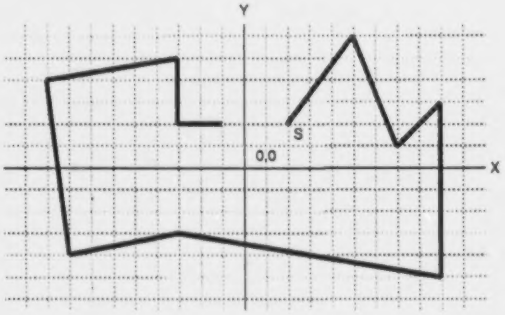
CARTESIAN COORDINATES



1. _____



2. _____



3. _____

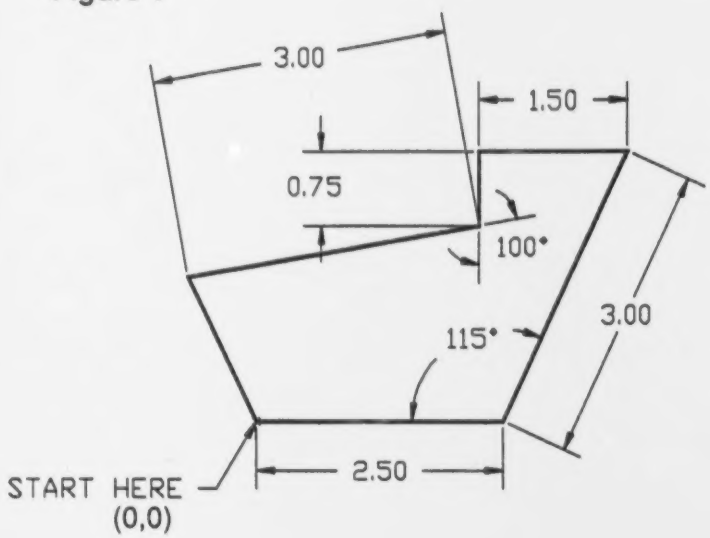
DIRECTIONS

1. Using cartesian coordinates, give the command to construct the figures.
NOTE: The letter "S" indicates the starting point.

CAD WORKSHEET NUMBER 3

RELATIVE INPUT

Figure 1



From _____

To _____

To _____

To _____

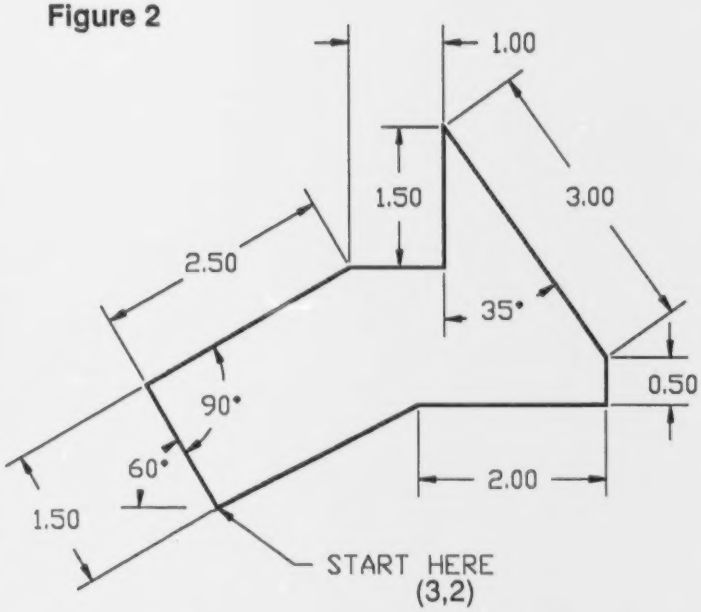
To _____

To _____

To _____

To _____

Figure 2



From _____

To _____

To _____

To _____

To _____

To _____

To _____

To _____

To _____

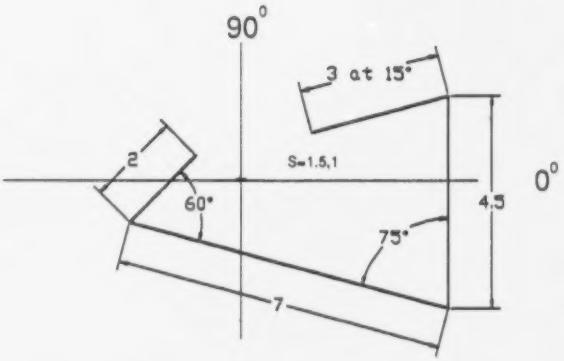
To _____

DIRECTIONS

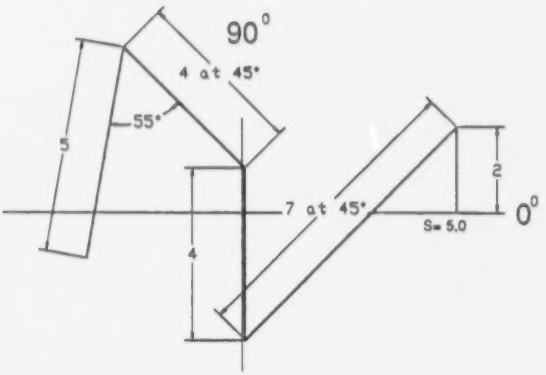
1. Fill in each line with the input required to produce the part.
2. Check your work by entering the commands into the CAD system.

CAD WORKSHEET NUMBER 4

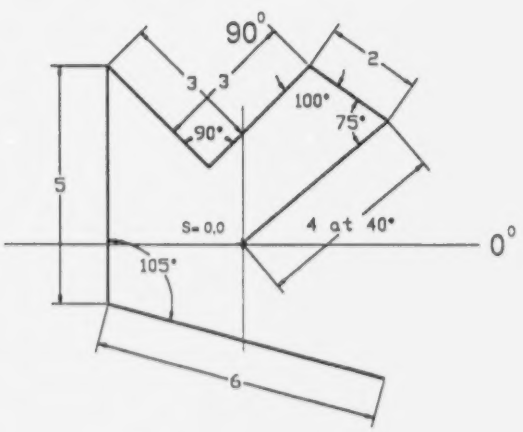
POLAR COORDINATES



1. _____



2. _____



3. _____

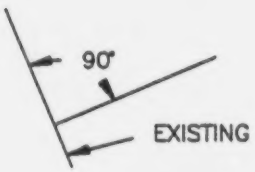
DIRECTIONS

1. Using polar coordinates whenever possible, write the commands needed to construct the figures above.

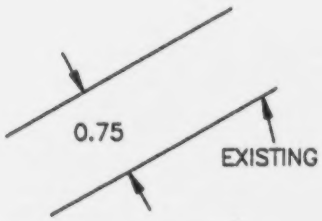
NOTE: The "S= x,x" indicates the starting coordinates.

CAD WORKSHEET NUMBER 5

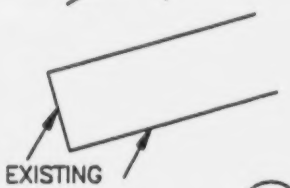
DRAWING COMMANDS



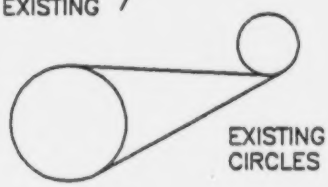
1. _____



2. _____



3. _____



4. _____

5. _____

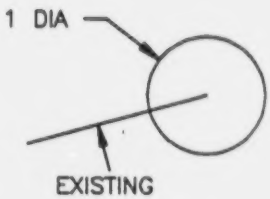
DIRECTIONS

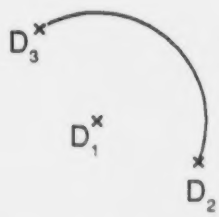
1. Write the commands and input as it would appear on your cad system in the spaces provided.
2. Indicate the digitizes (where you indicate points) on the drawings as D_1, D_2, D_3 etc. to correspond with the commands. *For example,* if you need to pick the end of a line in a command, place a D_X on the drawing to show where the digitize was made together with the written command.

CAD WORKSHEET NUMBER 6

DRAWING COMMANDS

HORIZONTAL
& VERTICAL LINES





1. _____

2. _____

3. _____

4. _____

5. _____

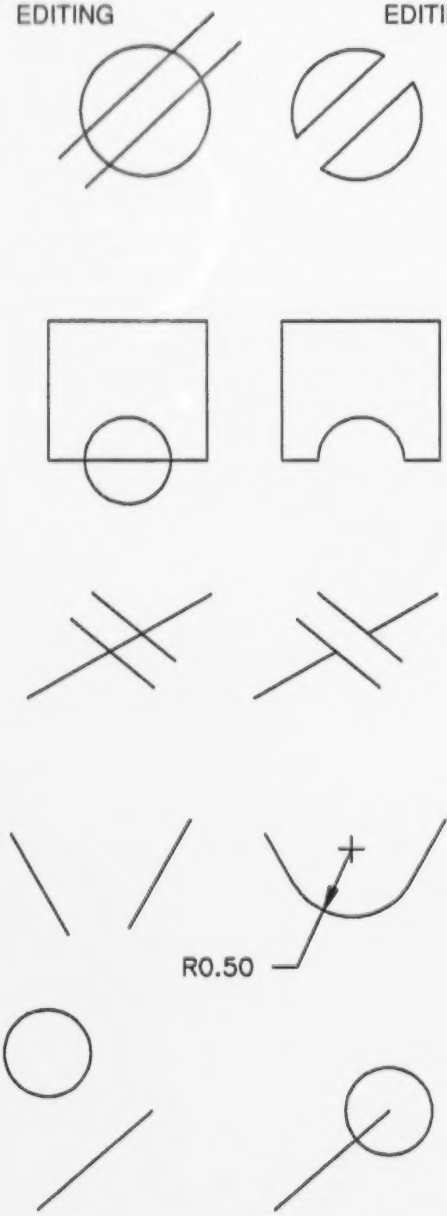
1. Write the commands and input as it would appear on your cad system in the spaces provided.
2. Indicate the digitizes (where you indicate points) on the drawings as D_1, D_2, D_3 etc. to correspond with the commands. *For example,* if you need to pick the end of a line in a command, place a D_x on the drawing to show where the digitize was made together with the written command.

CAD WORKSHEET NUMBER 7

EDITING COMMANDS

BEFORE EDITING

AFTER EDITING



1. _____

2. _____

3. _____

4. _____

5. _____

DIRECTIONS

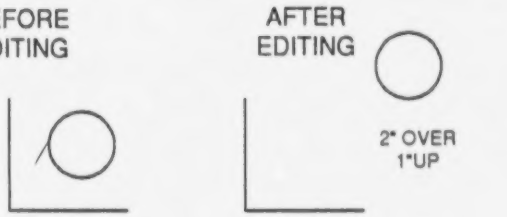
1. Write the commands and input needed to change the drawing on the left into the drawing on the right. Commands should appear as they would on your cad system in the spaces provided.
2. Indicate the digitizes (where you indicate points) on the drawings as D_1, D_2, D_3 etc. to correspond with the commands. *For example,* if you need to pick the end of a line in a command, place a D_X on the drawing to show where the digitize was made together with the written command.

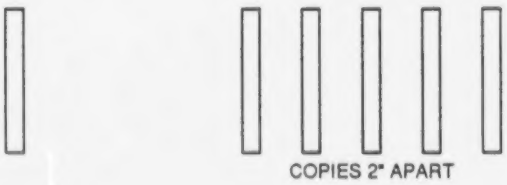
CAD WORKSHEET NUMBER 8

EDITING COMMANDS

BEFORE EDITING

AFTER EDITING





1. _____

2. _____

3. _____

4. _____

5. _____

DIRECTIONS

1. Write the commands and input needed to change the drawing on the left into the drawing on the right. Commands should appear as they would on your cad system in the spaces provided.
2. Indicate the digitizes (where you indicate points) on the drawings as D_1, D_2, D_3 etc. to correspond with the commands. *For example,* if you need to pick the end of a line in a command, place a D_x on the drawing to show where the digitize was made together with the written command.

CAD WORKSHEET NUMBER 9

EDITING COMMANDS

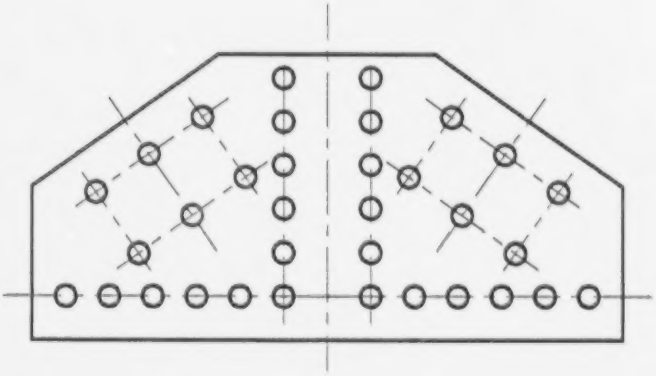


FIGURE 2

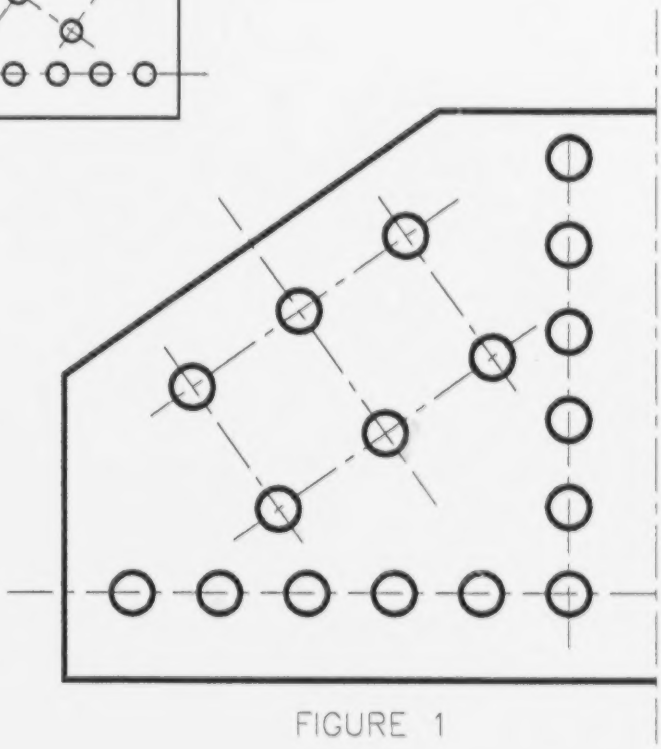


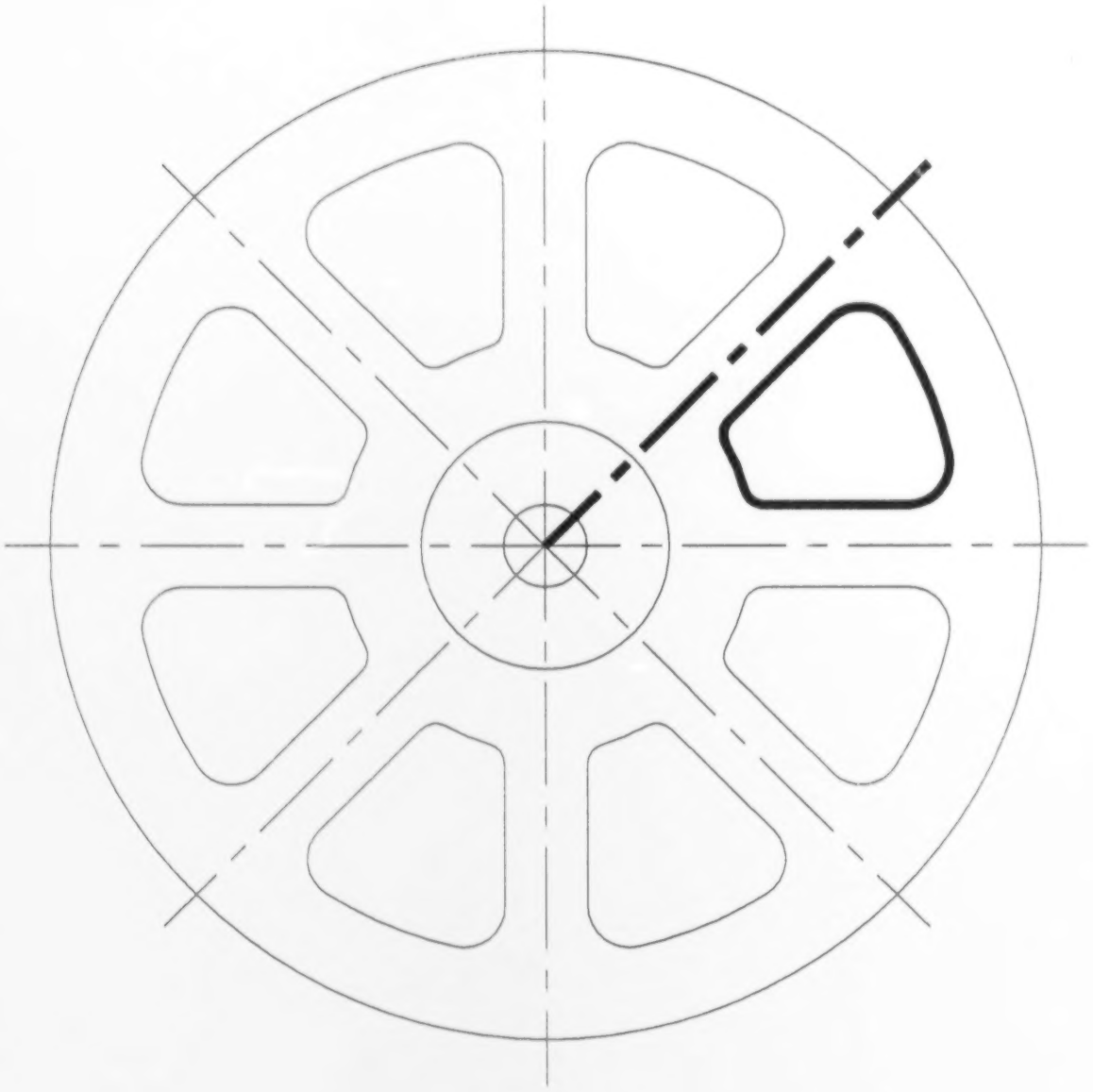
FIGURE 1

DIRECTIONS

1. Duplicate figure 1 shown above. Take dimensions directly from the full size drawing. Use editing commands whenever possible.
2. Mirror figure 1 to create the the finished drawing shown in figure 2.

CAD WORKSHEET NUMBER 10

EDITING COMMANDS

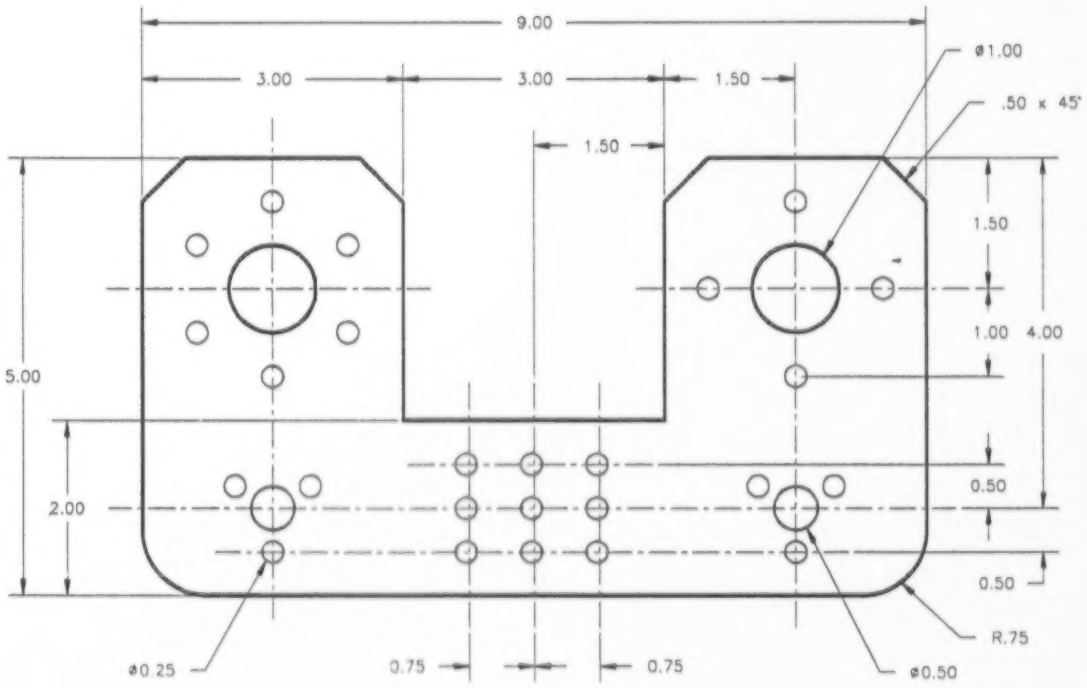


DIRECTIONS

1. Draw .5",1.5" and 6" diameter concentric circles.
2. Draw only those entities shown in bold. Take measurements directly from the assignment sheet.
3. Use the appropriate editing command to create a circular array of the bold entities to complete the drawing.

CAD WORKSHEET NUMBER 11

EDITING COMMANDS



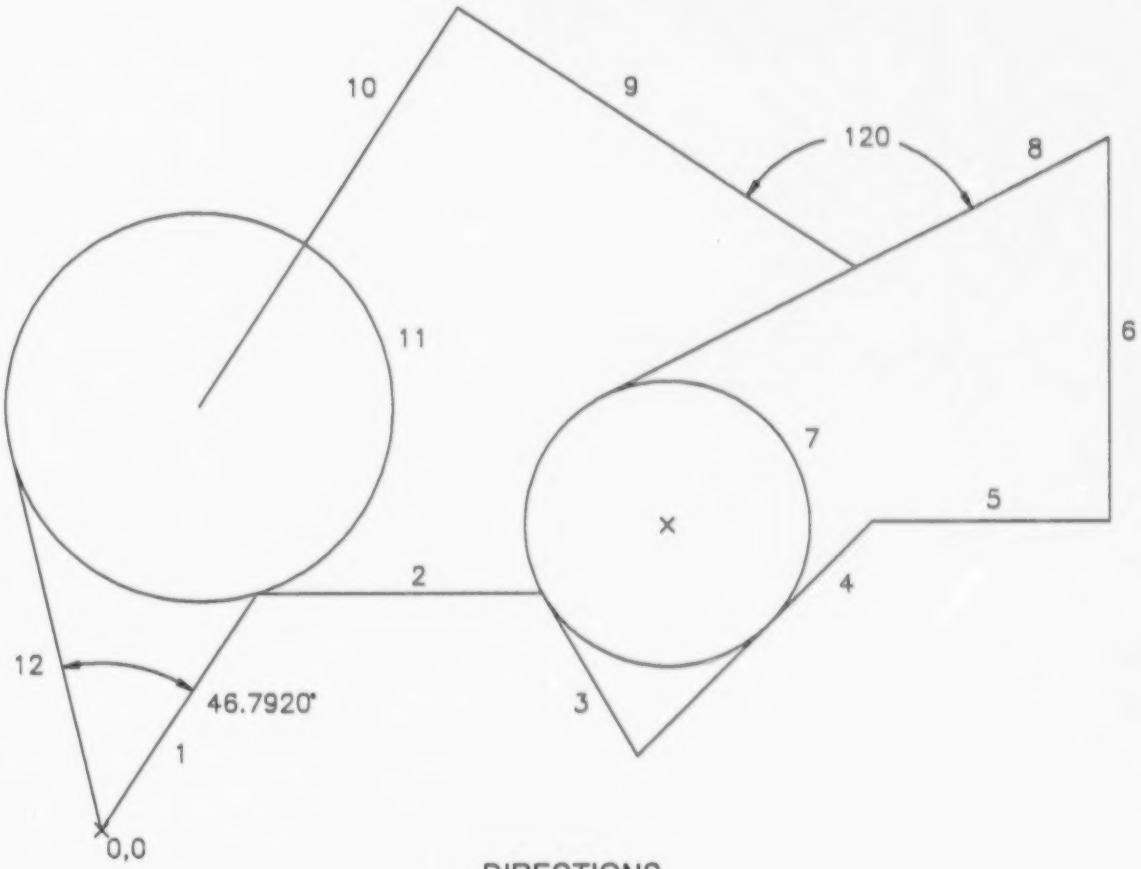
DIRECTIONS

1.Begin by drawing a 1" diameter circle and a 1"long horizontal line.
2. Complete the rest of the drawing using only edit commands.
Hint: Copy the original line and circle before editing so that you will always have them to come back to.

NOTE: Omit dimensions and center lines.

CAD WORKSHEET NUMBER 12

GEOMETRIC CONSTRUCTION



DIRECTIONS

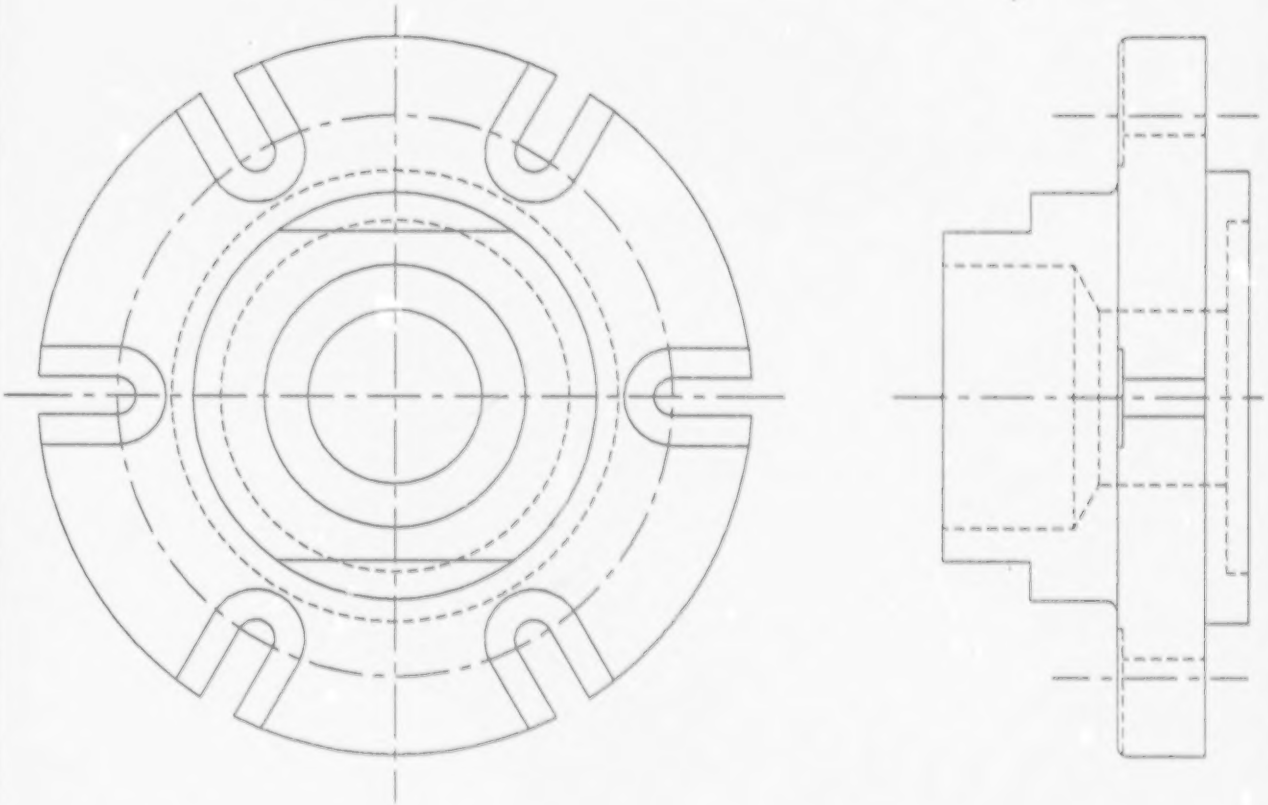
1. Line starting at 0,0 with a length of 3" and the opposite end 2.5" above the starting point.
2. 3" horizontal line.
3. 2" line at -60 degree angle.
4. Line of unknown length at 45 degree angle.
5. 2.5" horizontal line parallel to line 2 but .75 higher.
6. 4" vertical line.
7. Circle with 3" diameter that touches lines 3 and 4.
8. Line from the end of line 6 and tangent to circle 7.
9. 5" line from the mid point of line 8 and at a 120 degree angle to line 8.
10. 5" line from the end of line 9 and perpendicular to line 9.
11. Circle of unknown radius with it's center at the end of line 10 touching the intersection of lines 1 and 2.
12. Line tangent to circle 11 ending at 0,0.

13. Measure the angle formed by lines 1 and 12. If done correctly it will measure 46.7920 degrees.

NOTE: The finished drawing will fit on 11 x 17 paper at full scale.

CAD WORKSHEET NUMBER 13

DRAWING COMMANDS



DIRECTIONS

1. Duplicate the drawing above, changing the side view into a half section. The drawing is shown at half scale, your drawing should be full scale. The material is aluminum.

CAD WORKSHEET NUMBER 14

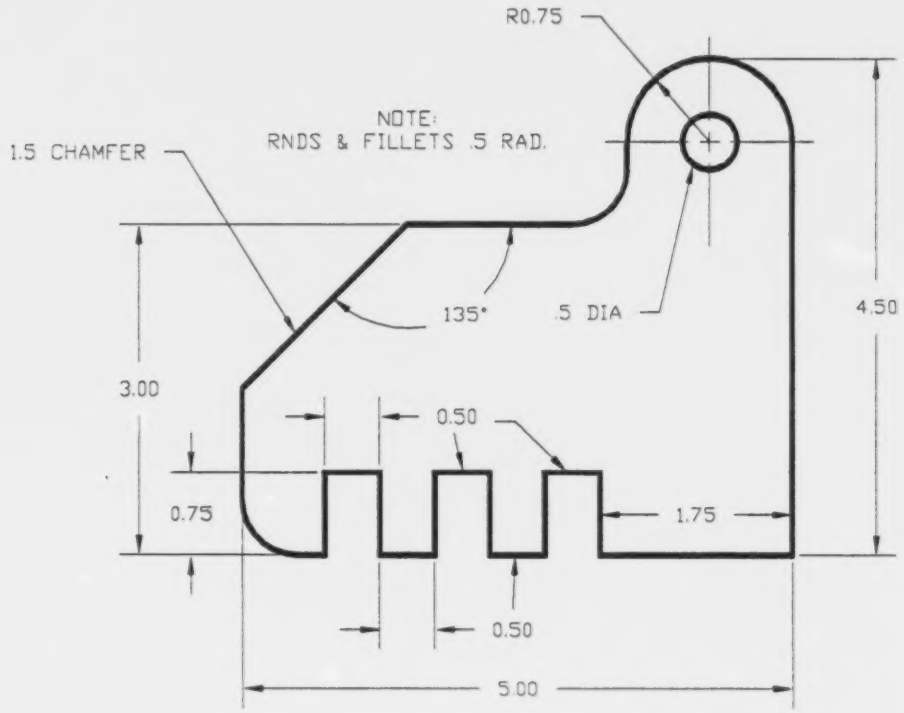
TEXT COMMANDS

DIRECTIONS

1. Create a certificate similar to the one shown above.
NOTE: To achieve the arced text, try making a circular array of a single character and editing (changing) the individual characters.

CAD WORKSHEET NUMBER 15

DIMENSIONING

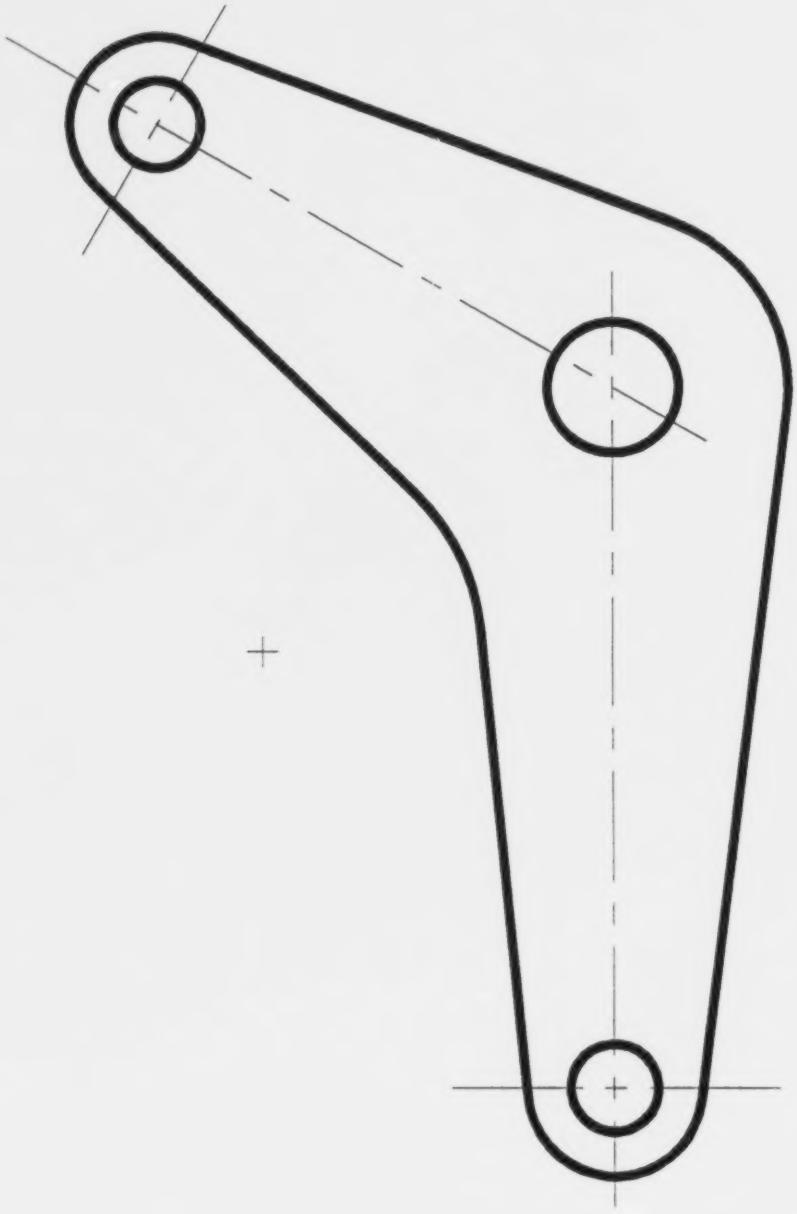


DIRECTIONS

1. Use the information above to create the drawing. (Full scale on an "A" size sheet)
2. Fully dimension the plate using proper dimensioning practices. Maintain accuracy to two decimal places.
3. The Finger Plate is made from 3/16" thick mild steel.

CAD WORKSHEET NUMBER 16

DIMENSIONING



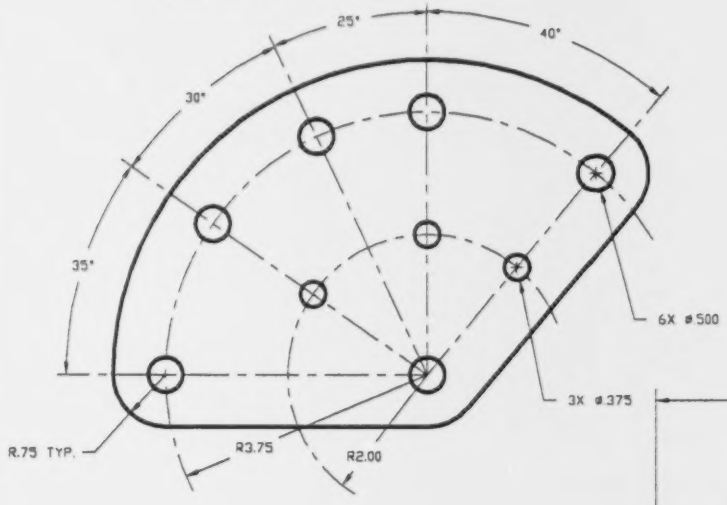
DIRECTIONS

1. Take size information directly from the drawing above. (Full scale on an "A" size sheet)
2. Fully dimension the plate using proper dimensioning practices. Maintain accuracy to two decimal places.
3. The Controller Arm is made from 1/8" thick mild steel.

CAD WORKSHEET NUMBER 17

DIMENSIONING

FIGURE 1



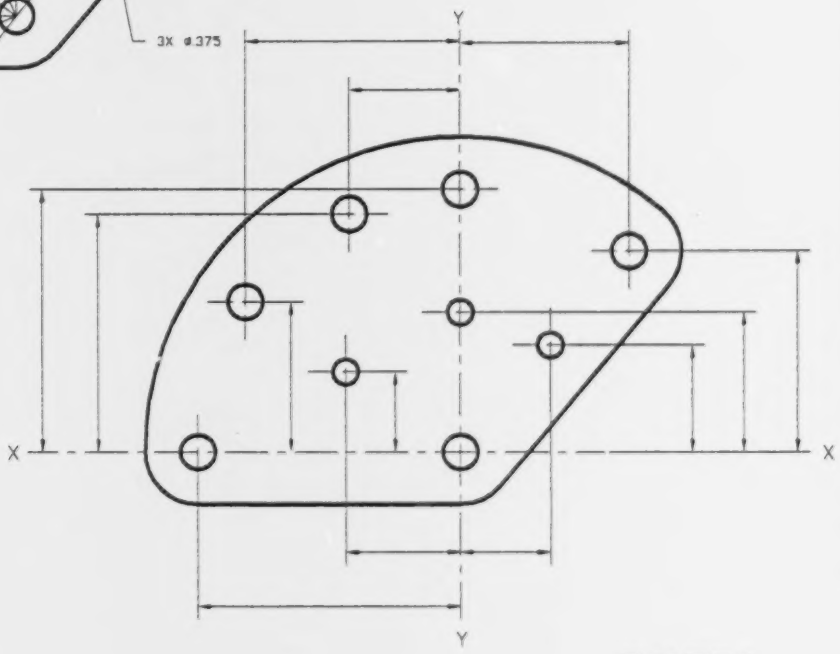


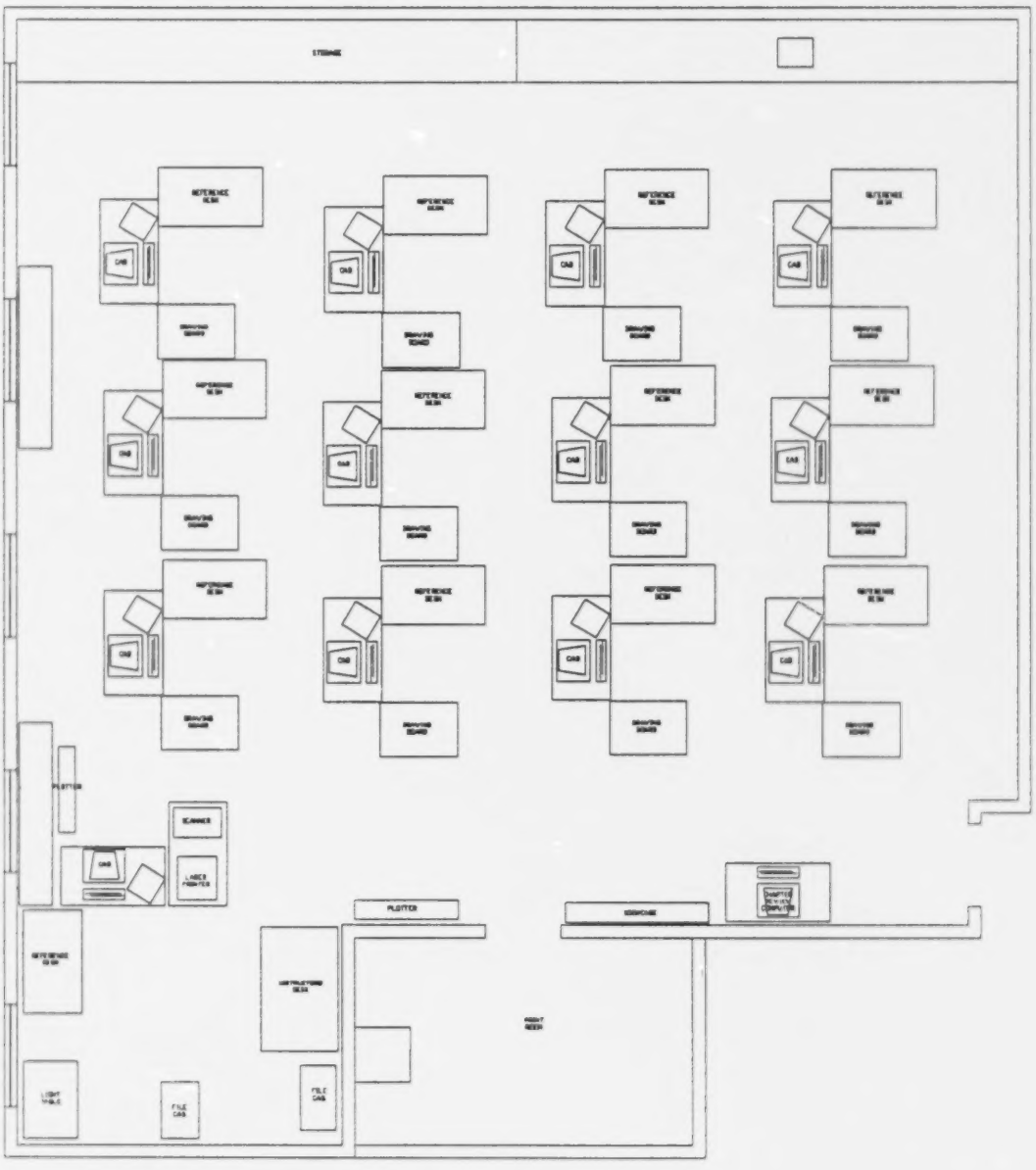
FIGURE 2

DIRECTIONS

1. Use the information in figure 1 to create the drawing.
(Full scale on a "B" size sheet)
2. Fully dimension the plate with all location dimensions
as shown in figure 2. Maintain accuracy to three decimal places.
3. The Side Plate is made from 1/4" thick mild steel.

CAD WORKSHEET NUMBER 18

SYMBOLS (BLOCKS)



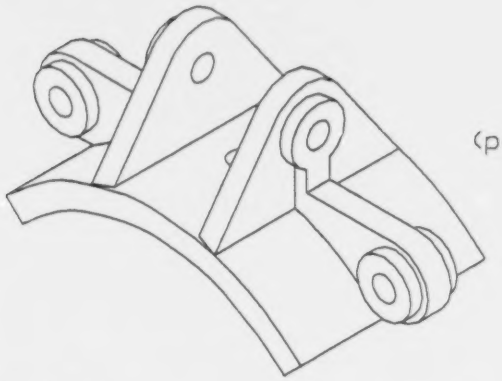
DIRECTIONS

1. Create a symbol library of the furniture in your classroom.
2. Create a drawing of the empty classroom. (This could also be saved as a symbol.)
3. Create a drawing of your classroom similar to the one above.

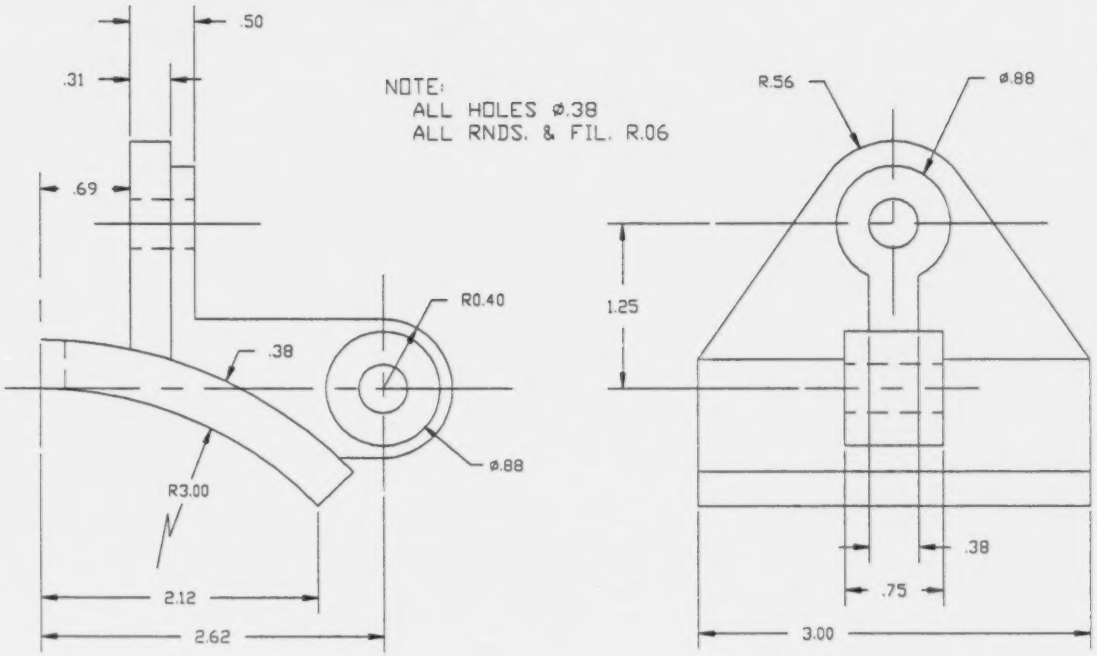
NOTE: An option would be to create a classroom of the future.

CAD WORKSHEET NUMBER 19

ORTHOGRAPHIC DRAWING



SADDLE BRACKET
(partial views may be incomplete)

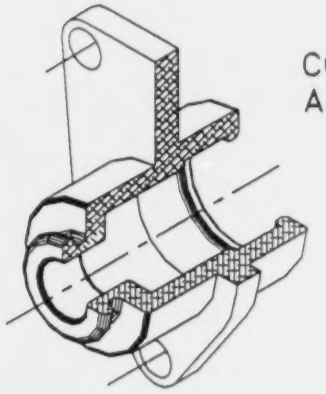


DIRECTIONS

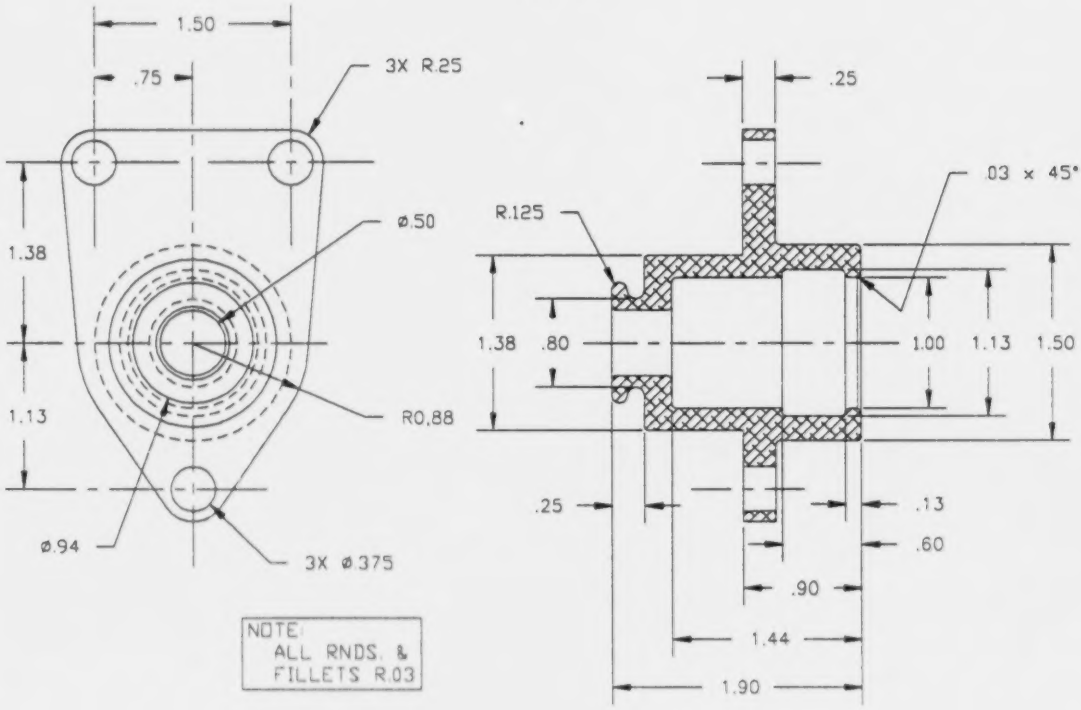
1. Prepare a complete orthographic drawing of the Saddle Bracket.
2. (Optional) Add dimensions.

CAD WORKSHEET NUMBER 20

3D DRAWING



CONTACT
ADAPTER



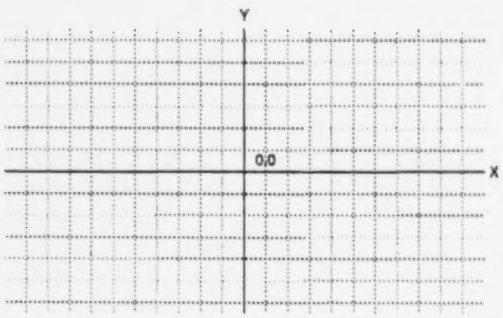
DIRECTIONS

1. Create the Contact Adapter as a 3D wire frame, surface model or solid model depending on your 3D capabilities.

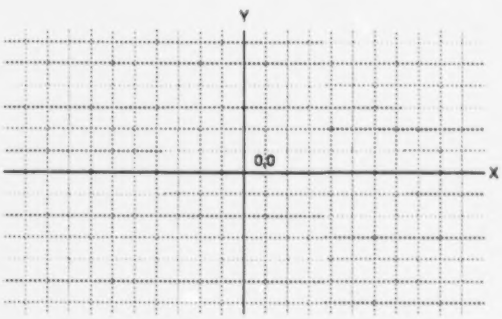
NOTE: As an additional assignment, project orthographic views from the 3D drawing or create a rendering.

CAD WORKSHEET

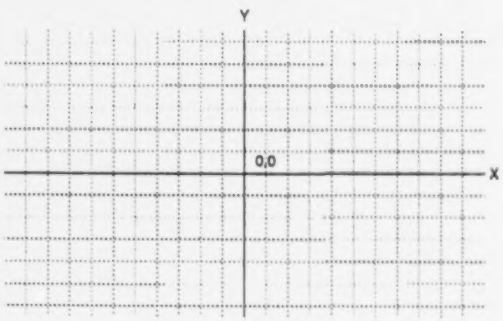
CARTESIAN COORDINATES



1. _____



2. _____



3. _____

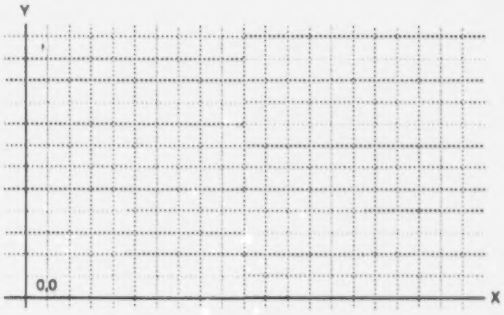
DIRECTIONS

1. Using cartesian coordinates, give the command to construct the figures.
NOTE: The letter "S" indicates the starting point.

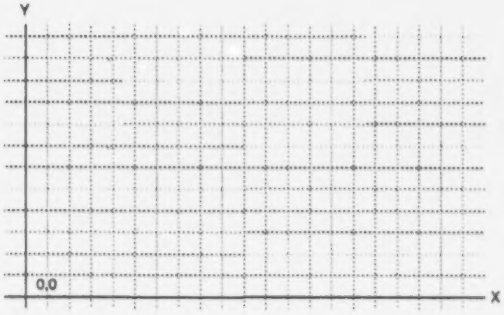
CAD WORKSHEET

CARTESIAN COORDINATES

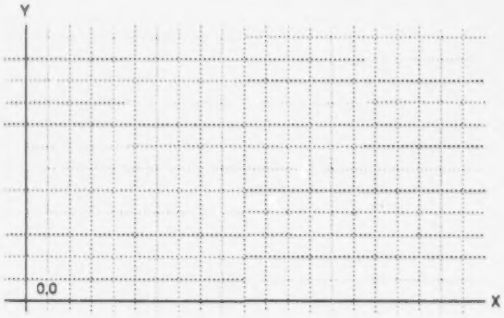
POSITIVE QUADRANT



1. _____



2. _____



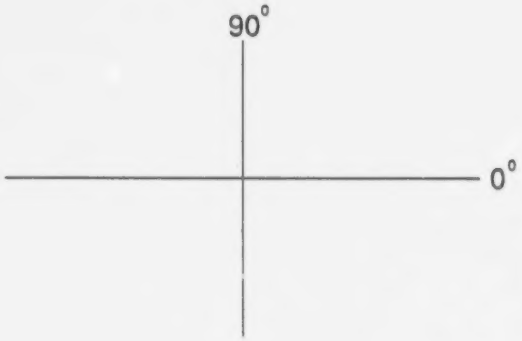
3. _____

DIRECTIONS

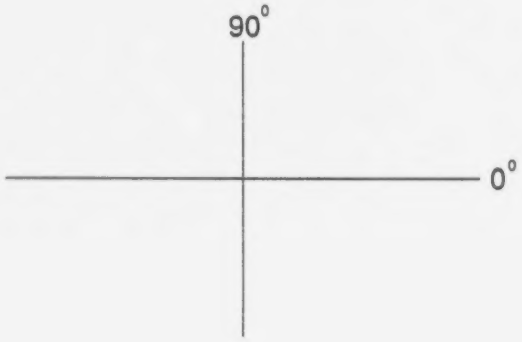
1. Using cartesian coordinates, give the command to construct the figures.
NOTE: The letter "S" indicates the starting point.

CAD WORKSHEET

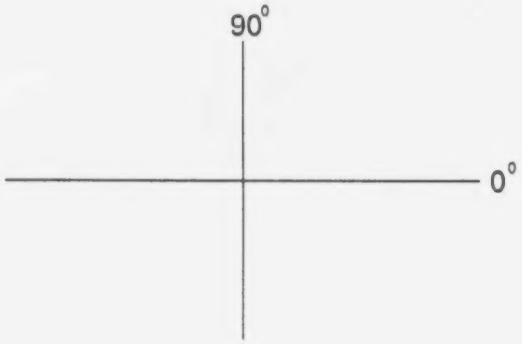
POLAR COORDINATES



1. _____



2. _____



3. _____

DIRECTIONS

1. Using polar coordinates whenever possible, write the commands needed to construct the figures above.
NOTE: The "S= x,x" indicates the starting coordinates.

CAD WORKSHEET

RELATIVE INPUT

Figure 1

From _____

To _____

To _____

To _____

To _____

To _____

To _____

Figure 2

From _____

To _____

To _____

To _____

To _____

To _____

To _____

To _____

To _____

DIRECTIONS

1. Fill in each line with the input required to produce the part.
2. Check your work by entering the commands into the CAD system.

CAD WORKSHEET

EDITING COMMANDS

BEFORE EDITING

AFTER EDITING

1. _____

2. _____

3. _____

4. _____

5. _____

DIRECTIONS

1. Write the commands and input needed to change the drawing on the left into the drawing on the right. Commands should appear as they would on your cad system in the spaces provided.
2. Indicate the digitizes (where you indicate points) on the drawings as D_1, D_2, D_3 etc. to correspond with the commands. *For example,* if you need to pick the end of a line in a command, place a D_x on the drawing to show where the digitize was made together with the written command.

CAD WORKSHEET

DRAWING COMMANDS

1.

2.

3.

4.

5.

DIRECTIONS

1. Write the commands and input as it would appear on your cad system in the spaces provided.
2. Indicate the digitizes (where you indicate points) on the drawings as D_1, D_2, D_3 etc. to correspond with the commands. *For example,* if you need to pick the end of a line in a command, place a D_x on the drawing to show where the digitize was made together with the written command.